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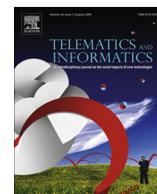
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Information and Telecommunications Project for a Digital City: A Brazilian case study



Denis Alcides Rezende^{a,*}, Gilberto dos Santos Madeira^{b,1}, Leonardo de Souza Mendes^{b,1}, Gean Davis Breda^{b,1}, Bruno Bogaz Zarpelão^{b,1}, Frederico de Carvalho Figueiredo^a

^a Post-Graduate Program in Urban Management, Pontifícia Universidade Católica do Paraná (PUCPR), Curitiba, Paraná, Brazil

^b School of Electrical and Computer Engineering, University of Campinas (UNICAMP), Campinas, São Paulo, Brazil

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ABSTRACT

Making information and telecommunications available is a permanent challenge for cities concerned to their social, urban and local planning and development, focused on life quality of their citizens and on the effectiveness of public management. Such a challenge requires the involvement of everyone in the city. The objective is to describe the information and telecommunications project from the planning of a digital city carried out in Vinhedo-SP, Brazil. It was built as a telecommunications infrastructure of the kind of “open access metropolitan area networks” which enables the integration of citizens in a single telecommunications environment. The research methodology was emphasized by a case study which turned to be a research-action, comprising the municipal administration and its local units. The results achieved describe, by means of a methodology, the phases, sub-phases, activities, approval points and resulting products, and formalize their respective challenges and difficulties. The contributions have to do with the practical feasibility of the project and execution of its methodology. The conclusion reiterates the importance of the project, collectively implemented and accepted, as a tool to help the management of cities, in the implementation of Strategic Digital City Projects, in the decisions of public administration managers, and in the quality of life of their citizens.

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1. Introduction

The availability of information and communication technologies is a permanent challenge cities concerned to their social, urban and non-urban, planning and development focused on the quality of life of their citizens and on the effectiveness of public management. Such a challenge requires the participation of everyone in the city, from municipal servants to the occasional dweller. Also, the permanent social, financial and political challenges faced by cities have demanded from city managers search for innovative solution in order to propitiate the suitable quality of life required by their citizens. On the other hand, the participation of citizens in the decision making process of a city is an unquestionable need. When facing these challenges, collective participation can be achieved by having an information strategic planning, to collect, organize and

* Corresponding author. Tel.: +55 41 3271 2623/9974 1168.

E-mail addresses: denis.rezende@pucpr.br (D.A. Rezende), gilmadeira@uol.com.br (G.d.S. Madeira), lmendes@decom.fee.unicamp.br (L.d.S. Mendes), gean@decom.fee.unicamp.br (G.D. Breda), bzarpe@decom.fee.unicamp.br (B.B. Zarpelão), frederico.figueiredo@pucpr.br (F.d.C. Figueiredo).

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¹ Tel.: +55 19 3384 1530.

synthesize all sorts of information (social, economic, political, environmental, etc.) as pre-requisite for the organization and management activities of the city.

The Municipal Information Planning can become one of the main tools for managing cities. In Brazil, because of insufficient financial resources in city budgets, obedience to the specific constraints and legislations, such as the Fiscal Responsibility Law, and pressures exerted by citizens and other social actors of the city (NGOs, investors, enterprise stakeholders, etc.) governments can be trapped into an intense pressure to assure good social and economic results for the city. This pressure can be minimized by the implementation information planning in the cities, propitiating the collective engagement of the “citizens for the city” with the implementation of a true participative governance model.

The development of broadband communication networks and the adoption of information and communication technologies (ICTs) are important factors for the economic growth of a country and, therefore, its municipalities. The *Global Competitiveness Index*, annually published by the *World Economic Forum* in the *Global Competitiveness Report*, takes into account the technological readiness of each country (Schwab and Sala-i-Martin, 2013). Qiang et al. (2009) show in their work, from an empirical analysis, that the increase of broadband penetration rate in developed and developing countries had a positive impact on the GDP. Firth and Mellor (2005) also defended the importance of broadband infrastructures for developed countries. They claim that ICT infrastructures are capable of generating economic growth and contributing to digital inclusion processes. These ideas have led Europe to the decision of building up a common policy for the implementation of an “Information Society”.

That policy, debated in the eEurope (2005) and in the i2010, defined the investment in broadband infrastructure as a priority (Alexiou et al., 2009). The challenge is that the construction of high speed communications networks demands massive investments, thus the interest of private investors will not be attracted unless business opportunities are equally devised in the enterprise. Therefore, it is up to governments to create conditions, both through regulation and as a major consumer, which may incentive the deploy of such investments from private organizations and, therefore, lead to the construction of worldwide broadband communications networks which are universally available to the public. Several European governments started to invest in broadband infrastructure through the establishment of Open Access Metropolitan Networks (Open Access MANs). The initiative of creating “open” communications networks of municipal proportions has turned out to be attractive to various governments. Beyond pulling new investments to the city, the “open” networks have implemented a telecommunications service network of its own, which results, at once, in money-saving with telecommunications servers. Along with those networks, other services can also be achieved, which reflects in efficiency gains and costs saving to the citizens (Qiang et al., 2009; Gómez-Barroso and Feijó, 2010).

In Greece, for instance, the city of Patras (third biggest Greek city) and the city of Messatida are the two main examples of success of those initiatives (Bouras et al., 2009). Similar cases are being debated and implemented in several other cities from countries such as Sweden (Alexiou et al., 2009), Ireland (Alexiou et al., 2009), Canada (Bouras et al., 2009), Spain (Ramos et al., 2009; Ganuza and Viéens, 2011), Denmark (Tadayoni and Sigurdsson, 2007), Chile (Hawkins, 2005), USA (Gillett et al., 2004; Fuentes-Bautista and Inagaki, 2006; Reinwand, 2007; Hudson, 2010), The Netherlands (Sadowski et al., 2009), New Zealand (CITYLINK, 2012), England (Sedoyeka and Hunaiti, 2011), Tanzania (Sedoyeka and Hunaiti, 2011), Korea (Lim and Kim, 2002; Lee and Lee, 2003; Picot and Wernick, 2007), and also Brazil (Mattos and Coutinho, 2005; Inocencio et al., 2008; Mendes et al., 2010; Breda et al., 2011).

Brazil still has a significant part of its population without access to Internet (Brasil, 2013). One possible alternative to contribute to the solution of that problem is the construction of the Open Access Metropolitan Area Network (MAN). Such networks can promote the universalization of the access to the population, counting on resources provided by a municipal multimedia network. Through the Open Access MAN, thousands of citizens and municipal organizations could have the opportunity to be included in the so-called *Information Society* (Lemos, 2005; eEurope, 2005). A relevant Brazilian initiative has been developed by the LaRCom (Laboratório de Redes de Comunicações) from the State University of Campinas (UNICAMP), Brazil. This group has been developing studies on Open Access Metropolitan Networks and Smart Cities, being responsible for optical high speed broadband communications networks deployment in several Brazilians cities, including the city of Vinhedo which is the one of the objects of our studies (Mendes et al., 2010).

Another problem is the inexistence or inadequacy of municipal information and telecommunications resources in its external and internal environment, corroborating the difficulties to manage cities and count on the respective participation of citizens in the city management and also in the urban and regional development.

The objective of this paper is to describe the Information and Telecommunications Project from the planning of a Digital City carried out in Vinhedo-SP, Brazil. Has as one of its main initiatives the development of the city's Open Access Metropolitan Network. This project enables the integration of the citizens in a single communications and e-Gov online services environment. The project has embraced the City Hall, its Municipal Secretaries, a Municipal Water and Sewage Company and other municipal institutions such as schools, health centers, and social squares for citizen attendance. With the project, the city has become able to structure, storage and make widely available a large amount of the information generated in and by the city.

The reason for this project is mainly related to structuring, storage and availability of all information and the sharing of knowledge mediated by telecommunications, which surely do not happen overnight and require short, medium and long term actions in the cities.

Recent studies reiterate efforts in projects of digital city to improve public policies and governmental programs by making information widely available to citizens (Weitzman et al., 2006). An US e-govern project has been trying to enhance the

interactive resources of the World Wide Web in order to improve the provision of services, democracy, fast feedback power, public awareness and trust in the government (West, 2004). A survey in 249 American cities formalized that the participation of citizens in public management broadens confidence in public services (Wang and Wart, 2007). In addition, other comparative studies developed between Taiwan and the United States evidenced technological integration excellence, with enough room to improve information supply and public services by using electronic government and digital city resources for integrating citizen and government (Chen and Hsieh, 2009).

The telecommunications and information planning, along with other municipal plans (e.g. Strategic Municipal Planning, Municipal Director Plan, Municipal Multi-Annual Plan, Governmental Plan and others), requires exhaustive practical exercises based on consolidated theoretical fundaments. These exercises are related to the regular daily activities of the city governments and their management. Such activities have to be prepared in an integrated and structured way, where personalized and timely information are essential factors for suitable and participative management of the cities. Evidently, these activities will be more profitable to the cities if they have effective participation of their citizens.

2. Theoretical fundaments

In order to have the concepts debated and understood some pertinent legislations of each country must be taken into consideration.

2.1. Information and municipal information model

For initial conceptualization, a piece of information is any data or data set processed to have some significance added to it and such that it can offer a natural or logical sense for those who use that piece of information (O'Brien, 2011). To be useful for decision-making, any information should not be abstract and should not have verbs. Also, it should be different from documents, programs, files and things alike (Rezende, 2012).

Information, and the systems which use them, perform fundamental functions in the management of cities, presenting themselves as a strategic resource for planning and management in an intelligent, competitive, and participative manner. To attribute strategic connotation to information, the organization usually goes through an evolving cycle in stages, such as: initiation, spread, control, integration, data administration, and maturity (Nolan, 1993; Turban et al., 1996).

The information acculturation process in municipalities can be made ease and effective if public managers and citizens (clients or information users) are participative, aware and thoroughly engaged in the utilization of information technological resources. The strategic information supported by information technology may occur in an evolving way, where information systems can be classified in several manners (Rezende and Abreu, 2013; Laudon and Laudon, 2011).

Information can have a highly significant value in society and those controlling it, a person, group or organization can stand for great power in society. The information valorization process comprises some logical phases and steps (WEITZEN, 1991; Stair and Reynolds, 2007). At least three steps are fundamental to add value to information: getting to know, selecting and using information. A badly prepared selection may cause major damages in the use of information.

The Municipal Information Model describes all the necessary pieces of information for management of city halls or cities (Rezende, 2012; Freitas et al., 1997). Such pieces of information can be structured in levels or types, i.e., strategic, managerial and operational information. They can be distributed according to their respective organizational functions or public issues. The Municipal Information Model document describes the strategic (in a macro-related way with the external and internal environment), the tactic and managerial (grouped and synthesized) and the operational pieces of information (in detail or analytical). Also, the Municipal Information Model may contain integrated information of the kinds: conventional (trivial), personalized and timely.

All and any peculiar or specific information can be used as personalized information, either being a natural or legal person or a differentiated product or service. It may also be regarding a single characteristic of a citizen. All and any information of unquestionable quality, however, anticipated can be named timely information (Rezende and Abreu, 2013).

2.2. Information System and Information Technology

An information system proposes as output the result of data or resource processing or transformed by any means (O'Brien, 2011). These information systems may be able to significantly contribute to solve many municipal problems, as far as they are used to generate suitable and personalized information (Rezende, 2012). They must be seen as tools to determine differential informational factors for municipalities and are defined as systems of human and technical components that accept, store, process, produce and transmit information, and can be based on any combination of human engagement, methods and information technology (Heeks, 2001). They are the means by which people and organizations put together, process, store, use and disseminate information (Ward and Peppard, 2002).

An information system can have operational effectiveness, large impact on municipal strategies and on the success of city governments, benefiting the citizens and any private individual or group that interacts with the municipal systems (Stair and Reynolds, 2007). The information system benefits are widely reported and justified in the specialized literature and papers. They can be seen as instruments for generating solutions for the municipal problems (Freitas et al., 1997; Laudon and

Laudon, 2011). To facilitate these solutions, the information systems should be integrated and allows information interchange among the several sub-systems composing it, which chiefly leads to natural information exchange amongst them. Such integration can also be named systemic vision, systemic approach, forest view, municipal gear, information synergy and harmonic set of organizational functions. Thus, information systems can be seen as integrated information sub-systems or organizational functions, divided into: production or services; commercial or marketing; material or logistics, financial, juridical-legal, human resources and their respective modules (Rezende and Abreu, 2013). Only through the integration of these sub-systems it will be possible to produce timely and personalized information.

The levels of information and decisions in the city governments can obey the pattern-hierarchy existing in most organizations (organizational pyramid). These levels are known as strategic, tactic and operational. The kind of decision taken in each level requires different degree of information and data aggregation. The various decision levels call upon different information in their several types of resulting products, such as screens, reports, etc. Practically, there is not a rigid classification, what allows people and administrations to classify their systems in different forms. All in all, IS can be classified in operational, managerial and strategic (Stair and Reynolds, 2007; Laudon and Laudon, 2011). The main difference among the information systems are in the form information is presented to users.

Operational information systems should provide very detailed information to users. Management information systems are developed to provide grouped or synthesized information to their users. The strategic information systems enable the comparison of information both inside and outside the city hall environments, also between other cities, and eventually generate some indicators and knowledge. Another way to classify information systems is based on the city administration scope. So considered, there are systems at personal, group (or departmental), organizational, and inter-organizational levels in which the global information systems are framed, involving several city governments of several cities (Kroenke, 2011).

The information technology (IT) or information and communication technology (ICT) can be conceptualized as computational and technological resources for data storage and generation and use of information. It is based on the following components: hardware and its devices and peripherals; software and its resources; telecommunications systems; data and information management (Stair and Reynolds, 2007; Turban et al., 1996; Rezende and Abreu, 2013). It can also be defined as telecommunications and computing technologies that supply automatic means and information handling, encompassing tangible hardware and intangible software (Heeks, 2001) and telecommunications networks (Ward and Peppard, 2002).

2.3. Information Planning and Information Technology Planning

The Municipal Information Planning is a project that formalizes the necessary information for city hall and town management and, as a result, plans the municipal information systems and their respective needs of information technology assets and human resources (Rezende, 2012).

The Information Technology Strategic Planning (ITSP) is a dynamic and interactive process to strategically, tactically and operationally structure the organizational information, the information systems, the information technology (and their resources: hardware, software, telecommunications systems and data and information management), the people involved, and the required infra-structure for assisting all decisions, actions and respective processes of the organization (Turban et al., 1996; Lederer and Mahaney, 1996; Rezende, 2012).

The alignment between the ITSP and the municipal plans and planning can be built upon the vertical, horizontal, transversal, dynamic and synergetic relations of the municipal functions and of the IT resources. Such alignment can promote the strategic and operational adaptation of available technologies in the city as a municipal management tool, put together by quality concepts, productivity, effectiveness, continuity, competitive intelligence and municipal intelligence (Henderson and Venkatraman, 1993; Rezende and Castor, 2006).

2.4. Digital City

The concept of digital cities regards the gathering and organization of the city information in a digital form to provide an information space where residents and visitors can interact among themselves (Besselaar and Beckers, 2009). It is the digital network environment, which interlinks advanced technological systems in order to connect public services, assets, brands, schools, third sector organizations, enterprises, and micro and macro communities, making information available in several orders and patterns, aiming to develop the Information Society potentialities and to transform the citizen into the main actor of this new virtual reality (Guerreiro, 2006).

One of the main cities concern is about the physical changes necessary to enable ICTs technical conditions and to ease the functioning of digital cities with their technological resources and respective conceptual, cultural and urban impacts (Atkinson, 1997; Shiode, 2000). They can also integrate urban information and create public spaces (Ishida and Isbister, 2000). The cities require new elements for their organization and reproduction of the urban area, providing the shrinking of distances in the form of extended cities, including the use of ICTs (Firmino, 2004) or like cities in a network (Batten, 1995; Townsend, 2003).

For Lemos (2005), science and technology become important for the urban area development. The challenges of the urban area should go beyond geographic boundaries and into the virtualization of the cities or in the cyberspace, bringing the possibility of distance annulation amongst the dwellers or citizens of a city, even if this annulation be just symbolic, as it is through digital communication (Lefebvre, 1991). The cities change due to the advent of new communication technologies

in a continuous move towards “de-territORIZATION” of symbolic worlds and the break-up of frontiers between the ancient and modern, between local and global, between written and audiovisual culture, leading to fast urban modernization processes in adequate environment for digital cities (Barbero, 1996). The exchange of telematics information help people get free from time–space confinement, traffic and other difficulties of physical places (Castells, 2005). The objective here is not the replacement of the real city with the virtual one; the focus is to increase citizens’ access to activities of collective intelligence and on the occupation of the cyberspace, as in the geographic city, fulfilling thoroughly the citizens’ needs (Lévy, 1999).

In the context of telecommunications applied to the cities, the digital city is also called “info-highways” putting together a set of Web applications, IP applications, services and equipment which provide a ubiquitous (which is everywhere at the same time) and pervasive (which spreads, infiltrates, penetrates) environment available to the citizen in a permanent basis. The digital cities, also known as cyber-cities, virtual cities, electronic cities, smart cities, and still other names, stand for a kind of projection of a city in a digital world (Mendes et al., 2010). Nowadays, many cities have been building infrastructures of broadband communications networks to offer high speed connection through different electronic services, allowing the offer of better public services, social networks for inclusion, increase social participation, etc. (Pazalos et al., 2010). They also take into account technological criteria of connectivity, accessibility and communicability (Duarte and Pires, 2011).

When referring to digital city, it is common to think on the offering of technology access to the population. But it also means to modernize public management and offer new services and commodities to people. A digital city can bring to people a new citizenship perspective with increased benefits, which may encompass, for instance, the integration and making available new services in education, health, safety, entrepreneurial economy, government, among others (Cidades Digitais, 2013).

Strategic digital city can be understood as the application of information technology resources in the management of the municipality and also in the availability of information and services to residents. It is a far-reaching project if compared to just offering internet to citizens through telecommunications conventional resources. It goes beyond digital inclusion of citizens in the world network of computers. Its ample projects include solutions as information systems for municipal management, providing electronic services to citizens, improving municipal safety systems, etc. (Rezende, 2012).

3. Research methodology

The research methodology employed here comprises an approach of applied nature directed to a circumstantial reality, with emphasis in the inductive method enhanced by the professional experience achieved by the researchers, both in advising projects for city administrations and in academic classes of undergraduate and graduate programs. This project also takes into account exploratory research concepts regarding documental and bibliographic studies (Nachmias and Nachmias, 2006; GIL, 2008).

The case study presented here, with emphasis in an action-research, had an applied research approach as well. It was an applied work because it generated new useful knowledge for the advance of science and for practical verification directed toward the solution or the facilitation of problems concerned to the planning of municipal information with the participation of the society (citizens and the municipal public servant) and of the management of a city (Marconi and Lakatos, 2008). It has put together other approaches explained by the eclecticism and integration of inseparable methods (Yin, 2008; Roesch, 2005; Vergara, 2012).

The materials and methods utilized are pertinent to available resources of research-action case studies. Forms were used for data gathering (planning, organization, diagnoses, analyses and debates), information tab, follow-up, controlling and documentation. Finally, it was carried out assessments of the procedures and actions performed. The research also used several investigative techniques, such as personal observation, questionnaires, field survey, semi-structured interviews, meetings and seminars, which were attended by common citizens, public managers, suppliers, and public service providers. That way, the surveyors were, in a cooperative and participative way, fully engaged in the process.

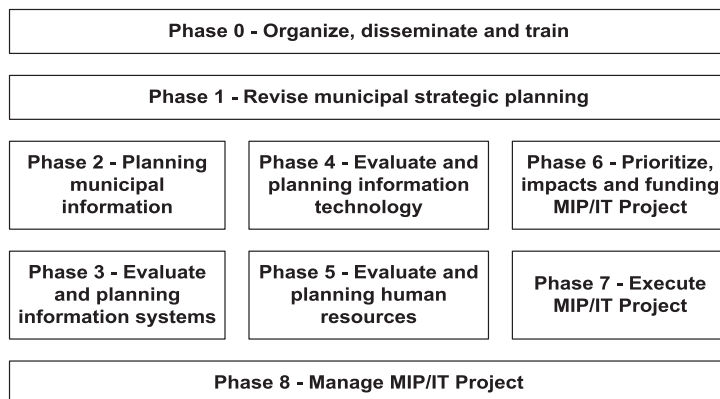


Fig. 1. MIP/IT project methodology (Rezende, 2012).

The project was accomplished from August 2009 to July 2010 by using the MIP/IT Project Methodology (Fig. 1) already carried out by other planning projects of municipalities. The sample of the research-action was applied in the city of Vinhedo-SP, Brazil. The unit of observation involved municipal servants and citizens (workers, students, retired people, housewives, city councilors, and entrepreneurs). The protocol of the research-action is an integral part of the methodology employed in the project whose variables are its phases and sub-phases. The project has been implemented since 2011. The Open Access Metropolitan Area Network (MAN) of Vinhedo was started in March 2012.

4. Planning project of municipal information

It is part of an ample project called Strategic Planning of Information and Information Technology for Strategic Digital City (MIP/IT Project). It includes the City Hall, its Municipal Secretaries, a Municipal Water and Sewage Company and other municipal units like schools, health centers, and social squares for citizen assistance.

Vinhedo has a population of 62,240 inhabitants. Before the implementation of this project, very little had been done concerned to the management of municipal information. What existed in terms of information technology was the result of disconnected actions without a well-defined goal, just consisting of searching non-formal and short term solution of specific problems, normally obtaining only palliative solutions.

The realization of the project demanded the definition of a methodology which formalized phases, sub-phases, products and approval point. The phases can be seen in the Fig. 1.

4.1. Phase 0 – Organize, disseminate and train

The first activity required to build the MIP/IT Project was its preliminary organization (Phase 0) which consisted of tasks accomplished before and during the effective development of the project. It had the following sub-phases: recognize the place of the MIP/IT Project; conceptualize the project; define its objective; adopt a methodology; determine the multi-disciplinary team (or project committee); disseminate the MIP/IT Project; train the people engaged; select management tools for managing the MIP/IT Project; and set up work plans for the MIP/IT Project phases and sub-phases. This phase was carried out during the project along with the Phase 8 – Manage MIP/IT Project.

4.2. Phase 1 – Revise municipal strategic planning

This phase was related to the review of the Strategic Planning of Vinhedo city. It put together the sub-phase *Identify municipal problems, objectives, strategies and actions*, and its sub-phases: work out municipal analyses; work out municipal guidelines; work out municipal controls; and management of municipal strategic planning.

Vinhedo does not have a Municipal Strategic Planning, what hampered the development of those sub-phases. Municipal analyses, problems and challenges, municipal guidelines, main objectives, strategies, and main actions of Vinhedo are just partially described in a document named Government Plan – 2009/2012.

4.3. Phase 2 – Planning municipal information

This phase was directed to the modeling of Vinhedo's needs for timely information and personalized knowledge. It put together the sub-phase *Identify municipal information* and its activities: list municipal information and model municipal information. This was one of the hardest activities as it covered 24 public or thematic municipal functions: administration; agriculture; science; technology and innovation; commerce; culture; education; sports; finance; government; housing; industry; juridical; leisure; environment; building; planning; health; sanitation, safety; municipal services; social; traffic; transport; and tourism.

A total of 1,331 Lists of Municipal Activities were elaborated. These lists contained the main municipal activities elaborated by the 15 Municipal Secretaries and a Municipal Water and Sewage Company. The municipal activities can also be figured out as processes of municipal tasks existing in each Secretary, including all the other municipal units.

In this phase the Municipal Information Models were also built. These models contained 18,200 pieces of operational and managerial information throughout the city, City Hall and respective units. By decision of the Management Project Committee, all the pieces of operational information (in detail) and all the pieces of managerial information (grouped) were formalized, and the strategic information (macro-related to the city and City Hall internal and external environment) was not formalized. The modeled information did not excluded redundant pieces of information.

4.4. Phase 3 – Evaluate and planning information systems

This phase was addressed to the identification and analysis of all current information systems of Vinhedo. This resulted in suggested adjustments to some systems and the planning of new systems of various kinds and levels.

The sub-phase *Evaluate municipal information systems* encompassed the activities: elaborate a work plan; identify city systems; describe city systems; and evaluate and summarize the current systems status.

In the Project Management Committee meeting was developed and recorded a work plan for the development of the systems encompassing the activities in the collective and individual way. The plan also defined tasks, responsibilities, priorities, and timing (beginning and ending dates), allocating the required resources and previewing the necessary development. The work plan Minutes are filed in specific binders archived in the city of Vinhedo.

The identification and description of all the municipal information systems were elaborated in specific documents which showed that all the systems required additions, i.e., they were inadequate to the city needs. The evaluation and summarization of the current situation showed 407 systems distributed as follow: 20 systems of a service provider company; 18 of various suppliers; 70 of Governments and Public Organizations; 214 of Microsoft™; and 85 of manual systems.

The sub-phase *Planning municipal information systems* presented the activities: review and detail municipal information; name proposed municipal information systems, diagram proposed municipal information systems; describe proposed information systems; validate proposed the municipal information systems, evaluate acquisition and development of proposed municipal information systems; and elaborate a demonstrative framework of proposed municipal information systems.

The proposed systems took in consideration the Government Plan 2009/2012 with 4 preferential thematic areas: social; economic; urban; and governmental development.

The Municipal Information Models were revised and altered by the Project Management Committee and completed with pertinent documents. Considering the Municipal Thematic, the Municipal Activities and the Information Models elaborated, the Municipal Information Systems were formalized also taking into account the debates held in the Vinhedo Society. On the total, 140 proposed municipal information systems were named, diagramed, described and planned involving the City Hall, its Municipal Secretaries, a Municipal Water and Sewage Company and other municipal entities. All the referred proposed systems were validated with the municipal servants of their respective Municipal Secretaries. For that, a demonstrative framework of the proposed municipal information systems was elaborated, containing the names of the Municipal Secretaries and the quantity of systems: Administration: 23; Agriculture: 8; Science and Technology: 2; Commerce: 3; Culture: 6; Education: 14; Sports: 2; Finance: 10; Government: 5; Housing: 5; Industry: 1; Juridical: 2; Leisure: 2; Environment: 4; Building: 2; Planning: 5; Health: 15; Safety: 4, Municipal Services: 8; Social: 8; Traffic: 1; Transports: 5; Tourism: 4; and Sanitation: 1.

As for the evaluation of acquisition or development of the proposed municipal information systems, all of them will be bidden and supplied by companies. These companies are specialized in projects, development and maintenance of information systems. No information system will be developed by insiders. At the same time, were sorted out and assessed 26 supplying firms of municipal information systems which could provide the modeled information and respective proposed systems.

To finalize this planning phase, a priority was defined by the Project Management Committee: the systems were addressed to public functions and public or municipal thematic such as social, public finance, and health. However, as there is a principle of unified database, the system architecture should prevent the recording of redundant data in the database.

4.5. Phase 4 – Evaluate and planning information technology

This phase focused on the identification and analysis of all the current resources of Vinhedo's information technology. Further, adjustments to some resources as well as proposed and planned new technological resources were suggested, in order to cope with all the Municipal Information Models and proposed systems.

The sub-phase *Evaluate information technology (IT)* comprised the activities: elaborate a work plan; identify existing IT; describe and assess current pieces of equipment and software; describe and assess current peripherals and pieces of hardware; describe and assess current telecommunications systems; describe and assess current management of data and information; describe and assess contingency, logistics, safety, auditing plans, and other IT policies; and elaborate general demonstrative framework of available IT.

During a Project Management Committee meeting Minutes were elaborated and recorded correspondent to a work plan for raising information technology resources.

All the existing information technology resources in the city were identified and analyzed. This activity covered all the information technology components: hardware; software; telecommunications systems; and information and data management.

The identification, description and evaluation of the software were part of the Vinhedo's information technology inventory. Thus, 692 pieces of software were evaluated and broken down as follows: Windows: 325; MS Office: 320; BR Office: 5; Corel Draw: 16; Photoshop: 7; AutoCAD: 17; TopoCAD: 1; and Windows Server: 1. The identification and evaluation of the hardware were also part of the Vinhedo's information technology inventory. This evaluation discovered 458 pieces of hardware distributed in 28 servers and 430 workstations.

The identification, description and evaluation of the telecommunication systems generated a mapped broad view of telecommunications places as well as the telecommunications resources of Vinhedo, including hardware and software used for telecommunications. The identification, description and evaluation of technological resources of data and information management showed that data backups and recoveries are manually elaborated on computers designated to public IT personnel. The control for getting the passwords is departmental and personal, and the navigation through the systems is only partially automatized.

The city government of Vinhedo does not have the contingency, logistics, safety, and auditing plans, along with other IT policies, formally elaborated. Likewise, the IT rules regarding operational technical norms and patterns for software, documentation and management of the projects are also not formalized. The IT concise demonstrative framework and its current technological resources took in consideration the specifications of previous items. The pertinent documentation relative to the resources of telecommunications systems, software, hardware, and data and information management as well as its details, are constantly updated and recorded in the Information Technology Department.

The sub-phase *Planning Information technology – software, hardware, telecommunications systems, data and information management* had the activities: develop strategies of IT components; define policies of management, operation, acquisition and legalization of IT components; plan the way to keep data and backup schemes of IT components; plan the way to recover information; define updating, installation and maintenance systems of IT components; define accessing control and accessing levels to the IT components; develop criteria of permanent control, safety, auditing and evaluation of IT components; elaborate contingency and technical reserve plans of IT components; and work out the general framework of IT components.

Strategies, policies, technical and operational norms and standards, and IT components configuration were partially elaborated and will be aligned with Vinhedo's objectives and strategies. On the occasion of the implementation of the Municipal Information Systems these documents will be finalized.

The configuration of telecommunications systems for Vinhedo will also be finalized by the implementation of the Municipal Information systems as it is the system of information itself that will determine the suitable configuration. A three-way Telecommunications Project has been being elaborated by a specialized firm to enable electronic data traffic among cities' buildings, institutions and homes. This project intends to provide internet for citizens, access to municipal information systems for managers and citizens, and resources for public security and traffic and public safety for the city. The premise defined for Vinhedo's telecommunications systems is the concept of "digital city".

The following sub-phases were partially elaborated: evaluate parallel infrastructure (elaborate work plan); identify the whole existing parallel infrastructure to IT; describe and evaluate parallel infrastructure policies; elaborate general demonstrative framework of the parallel infrastructure; and planning of the parallel infrastructure. This last sub-phase includes: develop the strategy of parallel infrastructure; define the management, operation, acquisition and legalization policies of the parallel infrastructure; plan and describe the parallel infrastructure; define the system of updating, installation and maintenance of the parallel infrastructure; develop permanent criteria of control, safety, auditing and evaluation; elaborate the contingent and technical reserve plan; and elaborate the general framework of parallel infrastructure.

The demonstrative spreadsheets of infrastructure resources parallel to IT of Vinhedo city and its inherent and pertinent detailed documents have been constantly updated and recorded in the Information Technology Department.

Was built as a telecommunications infrastructure of the kind of "open access metropolitan area networks" which enables the integration of citizens in a single telecommunications environment. Organize the information technology department. This sub-phase includes: design a work plan; assess the information technology department; define strategies for the information technology department; define a management model for the information technology department; define IT policies; define technical and operational norms and patterns of the IT; propose an organizational structure of IT; and elaborate a general framework of IT and necessary human resources.

The entire technological infrastructure and all the human resources of the information technology department of the city were evaluated based on the proposed professional profiles which are related to the set of necessary competences and skills.

It has been shown that the current Information Technology Department team is "small" and inadequate. It counts on four technicians for supporting the information technology resources of all the City Hall units. The facilities are also inadequate, bringing big risks for the current information technology resources.

The Information Technology Department resources should be aligned with the city objectives and strategies. Such strategies will be formalized on the occasion of the official implementation of the new Information Technology Department (including people and facilities).

The Information Technology Department policies respond to the general rules of its action and management and to the detailing of its procedures in the city. They focus on "what to do" in terms of orientation or general parameters. Like the strategies, the policies should be aligned with the objectives and strategies of the city. Such policies will be formalized on the occasion of the implementation of the new Information Technology Department (including people and facilities).

The operational norms and technical patterns of the information technology department are directed to the "how to do" in terms of general orientation and parameters. They encompass the manuals, the work forms, the standard layouts of software documents, and the pertinent legal aspects. They can also be suited to a determined quality tool or technical norm chosen by the city. Like the strategies and policies, such norms should be aligned with the objectives and strategies of the city. They will be formalized on the occasion of the implementation of the new Information Technology Department (including people and facilities).

The management model for the Information Technology Department should be aligned with the objectives and strategies of the city. Such a model will be formalized on the occasion of the implementation of the new Information Technology Department (including people and facilities). It has been recommended the creation of an Information Technology Committee made up of IT technicians and municipal servants. This committee should meet frequently to define activities and priorities concerning information technology resources and services from the strategies, policies, norms and technical operational patterns of information technology.

Besides the technical team, the organization of the Information Technology Department will demand the work of a suitable manager. The proposal suggested for managing the city, as a first option, is to have a Municipal Secretary of Science and Technology. A second option is to have an Information Technology Board (subordinated to Municipal Secretary of Administration). The main functions to be exerted by the Information Technology Department are: plan and execute activities related to information technology resources and of municipal information systems; define and accomplish objectives, strategies and actions of the information technology department; define and carry out policies, norms and technical operational patterns of the department and information technology resources; help the users of information technology and of municipal information systems, and their respective Municipal Secretaries. The team suggested to constitute the Information Technology Department is formed by the following professionals (preferentially permanent DAS people): information technology director; information technology manager; information systems support analyst (s); and information technology assistant (s). Optionally, by the completion of the development of the information systems, the Information Technology Department can take up the following professionals (preferentially permanent DAS people): information systems development analyst; database analyst; and information systems programmer.

The facilities or physical structure of the Information Technology Department comprises a suitable place (building) to allow the installation and operation of pertinent technological resources along with their respective suitable and safe environment. This building will house: hardware (computers, printers and peripherals); software (programs and utilities); telecommunications (connection between hardware, software and systems); management of data and information (backups, data recovery and control of access and navigation of information systems).

The Phase 4 – Evaluating and planning information technology has been being carried out in Vinhedo as can be seen in the sub-chapter 5.2. Project of digital city of Vinhedo.

4.6. Phase 5 – Evaluate and planning human resources

This phase focused on the analysis of the current human resource profiles of Vinhedo. As a result, was identified and planned new profiles of human resources necessary to help attend the needs of all the systems proposed and all the information technology proposed.

The sub-phase *Evaluate human resources* was elaborated with the following activities: elaborate a work plan; identify and describe the existing functions and positions; identify and describe the current professional profile of the human asset; evaluate competences and skills of HR involved in the process and organization; review the organizational structure; evaluate recruiting and selection of professionals of the organization; evaluate processes of current competences and training; work out a demonstrative framework of evaluation of human resources.

All the positions of the City Hall, the functions and positions related to municipal information systems and to information technology resources were examined.

The skills required for the city managers involve the action with three major competences: people or human resources; processes or activities or municipal projects; and diverse resources, such as technological, financial, material, of time and others. The profile of the “non-managers” or technicians in the city demanded three important skills: technical; of municipal activities; and behavioral (human). The profile of the “assistants” must meet the demands of these above respective and specific functions in the project and in the city.

All municipal servants who use current information systems were identified. For evaluating competences and abilities, reviewing organizational structure, evaluating recruitment and selection processes and evaluating preparation and competence processes, the City Hall allowed the hiring of the *Instituto Brasileiro de Administração Pública (IBAM)* to complement the elaboration of these sub-phases.

Was elaborated the sub-phase *Planning human resources - managers and “non-managers”* with the following activities: propose strategies of the human resources; propose organizational structure to the entire organization; define and describe the new professional profile and the roles of people in the organization; identify and plan necessary training; propose processes of recruitment and selection of people; propose processes of training and competences of the human resources; propose management policies for people management; and elaborate general framework of necessary human resources. The *IBAM* complemented the elaboration of this sub-phase.

4.7. Phase 6 – Prioritize, impacts and funding MIP/IT Project

This phase focused on the prioritization, impacts and funding on the execution of the MIP/IT Project of Vinhedo, when considering the evaluation and planning of Municipal Information Models, the municipal information systems, the information technology and the human resources.

The sub-phase *Establish priorities and needs* were elaborated contemplating the following activities: define priority methodology; elaborate a score framework for the development or acquisition and for implementation; and report the necessary resources for execution of the MIP/IT Project.

The first criterion of prioritization aimed the document Government Plan 2009/2012. From the criteria of priorities defined by the city, the following other priorities were established by the Project Committee Manager: telecommunications project (information highway with three main goals: public buildings interconnection, open access network, including free internet, for citizens; and public security and traffic safety for the city); implementation of a unified information systems

database; information systems of promotion and municipal social assistance; systems of public finance; and information systems of municipal health care.

The resources necessary for the execution of the project are being elaborated in formal documents and in accordance with the current Multi-Annual Plan. The city is also elaborating projects for evaluating and raising resources in the *Programa Federal de Modernização da Administração Tributária e Gestão dos Setores Sociais Básicos (PMAT)*. The possibilities of establishing public–private partnerships are also being considered.

The sub-phase *Evaluate impacts* was elaborated along with the following activities: foresee how the activities of all people engaged in the project will affect the organization; identify the measures to prepare the organization for the new IS and the new IT; report the positive and negative impacts; develop alternatives to minimize the impacts; and elaborate a framework of conditions and recommendations.

For the analysis of impacts of the MIP/IT Project, was elaborated a list of negative and positive points as well as alternatives or recommendations concerning the following impacts: political, cultural, behavioral, technological, budgetary, legal, of organizational performance and of municipal management. All the negative and positive impacts of the project are being described and managed by the Project Committee Manager, searching alternatives and recommendations to minimize the negative ones.

The sub-phase *Elaborate financial-economic planning* was created along with the following activities: develop the strategy and policy of investment return; elaborate analysis of costs, benefits (measurable and non-measurable), risks and viability; evaluate eventual implementation or optimization costs; and synthesize the financial-economic plan. The prioritization was elaborated according to two moments. First, the strategies and policies of the financial-economic plan and of the return of investments were aligned with the document Government Plan 2009/2012. Then, they will be aligned with the municipal objectives, with the strategies of the city and with the strategies and management model of the Information Technology Department. The necessary resources for the execution of the project are being elaborated in pertinent documents and according to the current Multi-Annual Plan.

The financial-economic plan with the analysis of costs, benefits, risks, return of investments and viability was elaborated specifically for each sub-phase or activity of the project implementation. The necessary resources for the execution of the project are being elaborated in pertinent documents and according to the current Multi-Annual Plan and, eventually, with the PMAT and Public–Private Partnerships.

4.8. Phase 7 – Execute MIP/IT Project

From the elaboration of the previous phases, this one is directed to the execution of the MIP/IT Project itself in the city, including the City Hall and other municipal units.

The sub-phase *Elaborate action plans* was created along with the following activities: elaborate chronograms for the development or acquisition and implementation of the MIP/IT Project; break down the chronogram into different internal and external activities; and elaborate the plans of implementation, action, and consolidated investments.

The work plans or chronograms were elaborated and broken down into different internal and external activities for the implementation of the project. Such work plans encompass the priorities established and give emphasis to: the development of alternatives presented; acquisition of solutions of information systems and IT resources; outsourcing of activities; implementations, adjustments or maintenance of systems; implementation of solutions; and others.

The proposed municipal information systems and their respective information technology resources should follow the objectives, the strategies and the actions of the city. They should be formalized by means of the Vinhedo's Strategic Municipal Planning Project to be developed.

The ongoing priority action plans were established by the Project Manager Committee, highlighting: telecommunications project (info-highway, i.e., presenting three telecommunications pathways: internet for the citizens, municipal information systems for the managers and citizens; and public safety for the city); implementation of Single Data Base (municipal information systems); information system of promotion and municipal social assistance; system of public finance; and information system of municipal health care.

Coupled with the bidding for priority municipal information systems, also three other bidding processes will be elaborated: projects of telecommunications engineering networking the whole city with optical fiber, radio communication systems and other communication technological resources; execution of the project of telecommunications engineering; and management of the resources of telecommunications with the integrated municipal information systems.

The Phase 7 – Execute MIP/IT Project was also executed in Vinhedo as can be seen in the sub-chapter 5.2. Project of digital city of Vinhedo.

4.9. Phase 8 – Manage MIP/IT Project

This phase has to follow the elaboration and execution of all the other phases.

The sub-phase *Manage, disseminate, document and approve the project* was elaborated along with the following activities: define the project's management format; disseminate the project; manage the project; work out a glossary regarding the terms of the MIP/IT Project; and present the project to the responsible committee or disciplinary team.

The project's management format comprehended the teams building, the definition of methodologies and their phases, the formation of people engaged, the planning and control of activities, the follow-up of the project, the dissemination of the activities carried out, the evaluation of their outputs or results and other pertinent actions. As management tools for the project, the following procedures were adopted: participative management; PMBOK/PMI™ adapted as a method; and Electronic Spreadsheet Excel™ as a technique of project management.

The dissemination of the project had as goal the commitment and engagement of all the City Hall's servants and a large participation of Vinhedo's citizens.

The project is managed by a Project Manager Committee (multi-disciplinary team). Beyond the Project Manager Committee, 5 municipal servants took over the role of direct collaborators, 27 as a Municipal Thematic Team, 3 representing the Information Technology Team, and other 170 municipal servants of all Municipal Secretaries participated with diversified functions.

The documentation of the project, coupled with the term glossary and the final report had as its objective the formalization and preservation of a documental record of the project. This activity also allowed a form of communication with the people involved directly or indirectly in the project.

All the project documentation is kept in a magnetic medium and also printed in paper and filed in folders in the Project Manager Committee's room. The documents concerning technological resources are filed in the Information Technology Department.

The project was continuously presented, assessed and approved by the people involved as well as the City Hall's servants and also the citizens of Vinhedo.

5. Telecommunications Project

The Telecommunications Project emphasized the municipal information highways and its municipal information resources and municipal services (Mendes et al., 2010).

5.1. Municipal info-highways and digital cities

The Open Access Metropolitan Area Networks (MAN) is telecommunications networks that aim to integrate the entire municipality in a single telecommunications environment. This model of network is able to trigger the development of the economy and of the society, influencing, among other things, productivity and capacity of innovation of a country. In Brazil, the municipal info-highways have been used to enable the existence of digital cities. The Open Access MANs are the telecommunications infrastructure that helps interconnect public buildings and also supply the citizens with broadband residential connection, propitiating digital inclusion. This telecommunications environment makes possible, among other things, the creation of the digital city or intelligent city. By means of Open Access MAN the whole city, including its citizens, get integrated in a single telecommunications environment.

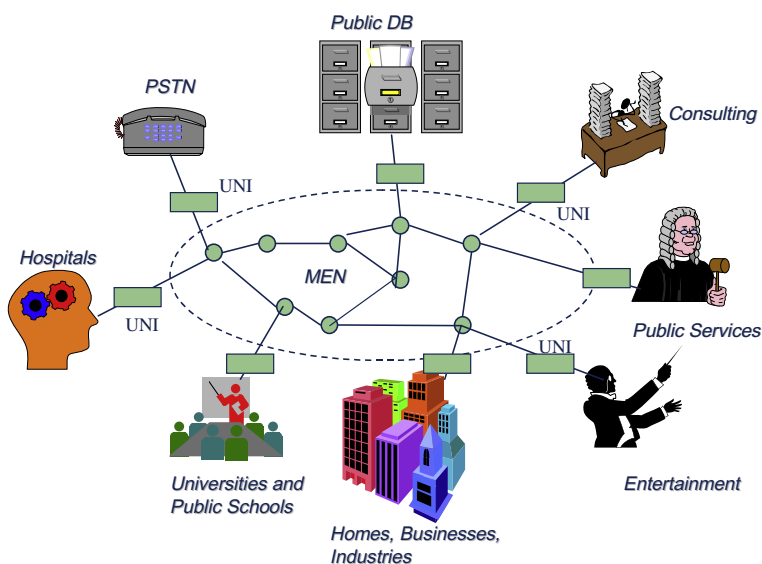


Fig. 2. Institutions and public buildings interconnected through an optical backbone that shelters all data flow of the city's units and also holds the telecommunications over IP service flow.

The Open Access MAN can be viewed as a bridge between the actual legacy and the new telecommunications models in which access to information is totally democratized. For that, it is created the Information super highway, that is, the infrastructure of communication, which comprehends all the infrastructure of communications necessary to make possible to the city the interconnection of its units through a high speed network, in which will operate an environment of communications based on Internet protocols.

The infrastructure of cables of Open Access MANs can be based on different technologies, depending on the physical characteristics and the requirements of transmission capacity for the Open MANs. Within available technologies, the most promising one is an infrastructure of transmission using an optical fiber network as physical environment. In the future, we foresee that the Open MANs may provide citizens the most different services (high speed Internet access, VoIP, videoconference, video over demand, Web TVs, Web Radios, citizen access to public services, e-business, e-learning, etc.). Fig. 2 presents a view of an Open MAN attending to general demand of applications and services of a city. This way, the use of high capacity systems is an exigency, such as for demand of services as for the need of attending to this demand for many years, what, nowadays, suggests the use of an optical infrastructure of transmission.

The optical network project must consider questions related to the city, such as public building distribution, concentration of commercial, industrial and residential regions, tourist interest points, public security interest points (security cameras), etc. Wireless networks – considering that, initially, the optical fiber rings covered part of city's departments – are necessary as alternative technologies to fulfill the city needs.

The initial goal of Open Access MAN is to interconnect public institutions and buildings, such as: municipal schools, city hall, health centers, hospitals, courts, etc. Afterwards, Open Access MAN's infrastructure can increase to allow additional services to be offered, such as universal Internet access to the city's population.

The Open Access MAN consists of hybrid optical wireless network, where the main infrastructure is composed by an optical backbone Gigabit Ethernet complemented by wireless Access cells based on the standards IEEE802.11 a and g.

The simplest approach considers the covering of the city with sets of wireless cells. These are based on the construction of a network of distribution nodes which are connected to the main backbone by optical fiber or wireless IEEE802.11a standard links. On the distribution nodes a wireless cell based on IEEE802.11b/g standard is installed. An important characteristic of these cells is that, in order to improve quality and throughput, they are made small, typically connecting no more than 60 points at a distance of, at most, 100 m. From these cells, the city is starting an offer program of free Internet access to citizens.

On the physical point of view, we can describe the Open MAN as divided into three layers: Access Layer, Distribution Layer, and Network Core.

The network core, normally built using a fiber optic backbone, forms the central part of the network. Being capable to transport hundreds of gigabits per second of information, the core is what guarantees that the Open MAN will support the full traffic demand of the city. In our project, the network core is built to attend the large bit rates generators of the city. These normally are the private and public data centers, universities and schools, hospitals and health centers, and other information relation enterprises of private and public origin. The must also take care of the Open MANs' interconnection with public service networks, like the Internet, public telephony, and TV distribution enterprises. Finally, the core must also offer the points for the interconnection of the distribution layer network. All these connections link themselves to the core through specific points called POPs (points of presence). Because of the high speed nature of the network core, we shall call these POPs as GPOPs (from Gigabit POPs).

The Distribution Layer is responsible to centralize the data flow in and out of the access points. This layer is composed of several distribution centers connected directly to the network core through a GPOP. Because of its function, the distribution center must be capable of handling from tenths of megabits per second up to a gigabit per second of data flow. A point of connection in this layer is called a DPOP. The DPOP can be constructed using several different technologies, from wireless technology to twisted pairs or even fiber links.

The Access Layer is responsible for handling the generic point of presence of the Open MANs. This point is aimed at connecting homes and small businesses. They derive from the DPOP forming distribution cells. The technology used must follow that adopted for the DPOP to which the distribution cell is connected.

On the logical point of view, the Open MAN, at least in the form we are now practicing it, is built upon the Ethernet and TCP/IP protocols. The Ethernet is a standard that treats the data communication on a local level (broadcast and/or collision domains). The Ethernet standard offers a variety of solutions that permit us to treat the several layers of the physical Open MAN infrastructure as being a single uniform layer. This standard is present in wireless solutions, cooper solutions, coaxial solutions, and fiber solutions.

One of the main advantages of the Ethernet technology is in its versatility. The first solutions were developed to allow interconnection of computers through a coaxial cable in a LAN environment. In this case, the cable operates as a single physical point that all computers must use to signalize information to the other computers. Thus, because a single point is available and more than one computer may want to send information at the same moment, a mediation protocol must be established. The Ethernet standard defined a collision detection mechanism called CSMA-CD (Carrier Sense Multiple Access with Collision Detection). Modern Ethernet systems have distanced enormously from the first ones. Today, Ethernet like solutions can be found to be operation upon cooper, wireless, coaxial, and fiber. Several improvements have been made in the protocols. Originally Ethernet could only take care of communications on the collision domain. Today, it is possible to have the broadcast domain of Ethernet solution to spread beyond the local physical boundaries by extending VLANs upon a large Metro Ethernet area.

Another important property of this solution is its low cost. In fact, when compared to the normal costs associated to the construction of SDH, ATM, or WDM networks, an Ethernet hybrid optical-wireless backbone is almost negligible. Also, the operation and management of an Ethernet backbone is a lot simpler than these other more sophisticated technologies. However, the use of such infrastructure in a promiscuous environment like Open MAN promises to be requires the development or improvement of several technologies, including security resources like those necessary for identification and authentication of users, equipment and systems using the network.

To complement the Open MANs' logical architecture, a solution has to be used the forward traffic among the several public and private networks that may live inside the city network, to allow traffic exchange between Open MANs attending different cities, and also to permit traffic exchange between the city network and external service providers like interconnection to the Internet or to the PSTN (Public Service Telephone Network).

Because of its universality, TCP/IP, the Internet's choice of network protocol today, is certainly the best candidate to become the data exchange protocol of Open MANs. In fact, TCP/IP is not a single protocol. It is a family of protocols that work together to solve the several issues that should be treated when information must be sent travelling through that various cooperative networks that composed a single large network like the Internet. Fig. 2, below, show the TCP/IP protocol stack based on data flow model.

Originally, the network forwarding protocols of TCP/IP (i.e., the IP protocol) was developed to be a best effort network platform. This means that such a network does not guarantee the final delivery of information. Any guaranties must be offered by superior layers of the protocol stack. In fact, the TCP protocol was developed to offer such guaranty. However, TCP/IP as developed in such way that "in the end, things would work out fine".

Such concept of quality of service is not sufficient for a network model that aims to become "the choice" for convergent networks. Thus, what has happened to TCP/IP that transformed it from the communication backup network for the cold war age to the modern, advanced, high speed, QoS aware, Internet and (in several cases) telecom industry network of choice. And the answer is simple: technology evolution and revolution. Electronics, microelectronics, nanotechnology, digital technology, communication technology, data networks, wireless networks, optical networks, software engineering, and so many other contributions have paved the way for a universe of the possibilities for TCP/IP. Today, with the development of several new protocols to its family stack, like Ipv6, DiffServ, MPLS, RTP, and many others, TCP/IP is ready the demand the crown of the new network "for everything". The concept of "All over IP" has been launched, and we have adopted it for our conception of Open MAN, an open access ubiquitous community network for cities, capable of handling any communication demands of the "Knowledge Age" modern society.

One example of the potential of an Intelligent City lies on the supplying of broadband accesses to Internet. By means of Intelligent City networks, it is possible to offer the citizen a broadband connection free of charge. Empirical analyses carried out by Qiang et al. (2009) showed that each 10% points of growth in the penetration of broadband implied in a growth of 1.21% in the developed countries' GDP and 1.38% in developing countries' GDP. Therefore, the democratization of broadband access should be one of the main goals of the government public policy concerning the Telecommunications Sector.

In countries such as Spain (Ganuza and Vicens, 2011), Greece (Alexiou et al., 2009; Bouras et al., 2009; Kyriakidou et al., 2011), Ireland (www.enet.ie), The Netherlands (Sadowski et al., 2009), Denmark (Tadayoni and Sigurðsson, 2007) and Sweden (www.stokab.se), the building of public metropolitan networks has been one of the options adopted to improve the infrastructure of cities. Municipal Networks can be defined as a communication public environment (network) aiming to

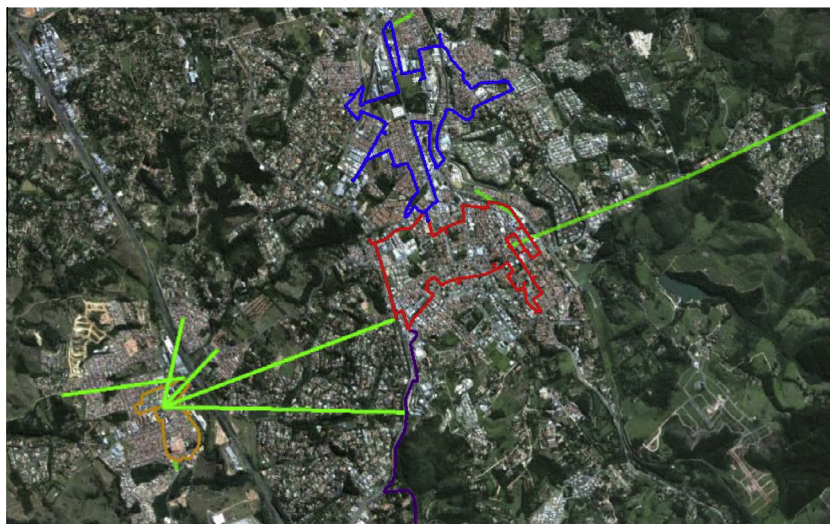


Fig. 3. Optical fiber and radio links.

meet the needs of interconnection of municipal governments and get ready for universalization and digital inclusion for all inhabitants of the municipal area. The Municipal Network stands for an alternative at lower cost to the final user and allows the construction of a universalization model which propitiates the modernization of public administration, digital inclusion in all levels, social inclusion of citizens, enhancement of local digital economy, cost reduction of communication services and the general economic reinforcement of the municipality (Mendes et al., 2010).

The Network Communications Laboratory of School of Electrical and Computer Engineering at University of Campinas (UNICAMP) designed approximately 32 Open Access MANs available to several cities in Brazil. The laboratory has wide experience in project-making and development of this kind of project.

5.2. Project of digital city of Vinhedo

The phases 4 - Evaluating and planning information technology and 7 - Execute MIP/IT Project (Fig. 1) are being complemented in the execution of the Project of Digital city of Vinhedo.

The Open Access MAN of Vinhedo was inaugurated in March 2012. It was created on a network composed by 40 km of single-mode optical fiber, cable with 24 fibers. There are three rings of optical fiber (red, blue and orange), Fig. 3, and an optical branch (violet). There are about 13 links of radio (green). The links of radio use 5.8 Ghz frequency, Wi-Fi IEEE 802.11a, Fig. 3.

There are about 24 cells of wireless coverage distributed through the city, already installed, Fig. 3. Other 25 are in phase of installation. The coverage cells employ the 2.4 Ghz frequency, Wi-Fi IEEE 802.11 g/n, Fig. 4. After 3 months since its inauguration the city has already connected 500 houses to Internet. According to some projections, in about a year and half, we will have connected 50% of the residences to Internet, utilizing 512 Kbps broadband access.

By having a telecommunications infrastructure, interconnecting all the public buildings, it is possible to integrate several systems and offer many services.

The Project of Information and Telecommunications for the Digital City, contemplating the Open Access MAN, has enabled some benefits to Vinhedo, as much to the citizens as to their public managers. Some of those benefits were: dissemination of the culture of information, systems and telecommunications; democratization of the access to municipal services; money-saving by having its own telephony system; availability of resources for distance education, digital literacy and developing of virtual libraries; possibility of creating new jobs and attracting new companies to the municipality; transparency in the public administration actions, improvement of the quality of services offered to the citizens; stimulus in the relationship between government and citizens; and also strengthening of the democratic process by means of a truly digital inclusion.

The Digital City of Vinhedo can also be seen as a bridge between the current legacy and the new models of telecommunications, in which the access to information is totally democratized and participative. For that, it was created a “super highway” of information, a communication infrastructure that comprises all necessary infrastructures so that it makes possible for the municipality to interconnect their public service units with the high speed network. The *Project of Digital city of Vinhedo* will also be providing the citizens with other various services (access to high speed Internet, VoIP, video conference, video on demand, Web TVs, Web Radios, access to public services, e-business, e-learning, etc.), aiming a better life quality.

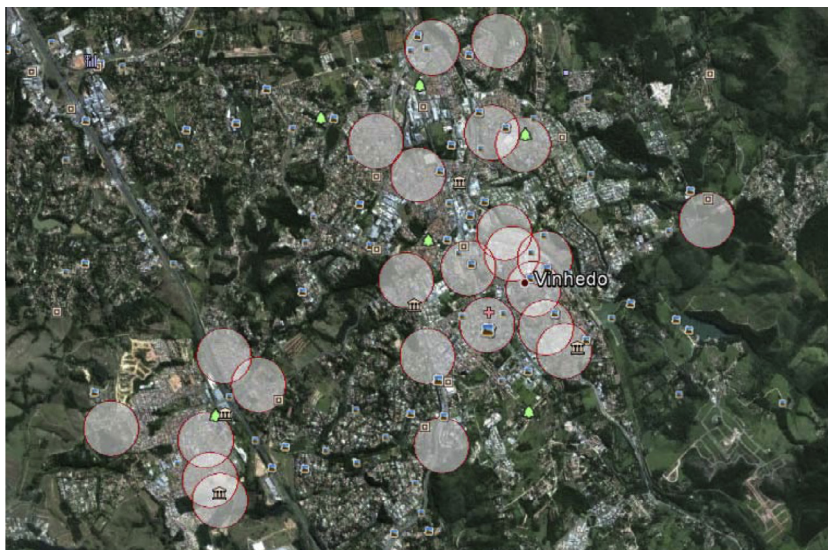


Fig. 4. Radio cell coverage for interconnecting citizens.

This in-progress project should not be compared to other already consolidated projects of big cities, mainly to American, European and Japanese cities.

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6. Conclusion

When developing a city planning it is important to gain the participation of their citizens and the engagement of their local managers to expand social, urban and regional development. To accomplish that it is necessary to plan and make available information and communications in a suitable and transparent way.

From the point of view of the municipal manager, the planned information and respective telecommunications can contribute to the management of the cities. From citizens' participation viewpoint, this consideration may also contribute to the exercise of citizenship by promoting people participation in the planning, structuring, preservation and availability of information and their use and benefit regarding the enhancing of life quality. From this discussion it becomes clear the necessity for cities to enlarge their activities of communication, education and social development, mainly because the majority of them face constant social, financial and political challenges and this approach can provide jump toward effective management leading to better quality of life for citizens.

Undoubtedly, the municipal information and telecommunications planning, like the municipal strategic planning, can become an indispensable participative management instrument of city halls and cities. With the right modeling, planning, information availability and municipal services offering through telecommunications, it makes possible breakthroughs in citizenship building in the public space, in municipal democratic governability, in transparency of management and in urban and regional development of the cities.

One can say that the overall goals for this work in the city of Vinhedo have been reached as described in this paper. The referred project involved the City Hall, its Municipal Secretaries, a Municipal Water and Sewage Company and other municipal units, such as school, health centers, and social squares for attendance to the citizens. The bottom line of this planning was the participation of municipal servants and citizens, namely, workers, students, retired people, housewives, city councilors, entrepreneurs, among others, in the creation of the Digital City of Vinhedo.

The first impact was the elaboration of 1,331 Lists of Municipal Activities containing the main activities or processes of elaborated municipal tasks. It was a challenge because the City Hall had not documented its activities in a structure organized as the science of administration asserts. However, further, the people involved were prepared and motivated to participate of the MIP/IT Project of Vinhedo and to elaborate, in a collective way, the models of information, the evaluation and the planning of all municipal information systems.

The social players involved propitiated the integration of technological resources with social participation in a democratic and popular experience. Together, local managers and citizens, by means of an organized project, could model 18,200 pieces of managerial and operational information for all the city, City Hall and respective units. Such information formalizes their wishes, interests and personal needs which, one can say, was addressed to the city reality. Beyond these pieces of information, they could plan and prioritize 140 municipal information systems proposed.

Regarding telecommunications and free of charge internet, the project already reaches over 150 residences and over 400 citizens. For these citizens, the following main municipal services were made available: opening, alteration and closing of firms; electronic invoicing; citizen's portal with personal information, property information, etc.; health card; daycare and school online services; servant's portal with personal information about payments, vacations, etc.; transparency portal with municipal processes follow-up. And for the public managers (Mayor, Secretaries, Directors, and municipal servants) countless pieces of information were made available to help them make better knowledgeable decisions.

Evidently there were many difficulties throughout the elaboration of the phases, sub-phases and tasks to plan in a participative way the information and telecommunications of the city. However, such difficulties were day by day and collectively overcome, either by the local administration or by the citizens and organized civil society that took part in the realization of the MIP/IT Project of Vinhedo.

Concerning the contributions of this work, they report the practical viability of the project developed and of the execution details of its methodology. Such contributions are addressed to the academy, to the participant city of the case study, and to

other cities. To the academy, it is highlighted the project elaboration methodology in a participative way, putting together interests of local managers and of citizens.

The case study described can also facilitate other similar researches to understand their challenges coming from urban and regional planning and development, as well as, from public management that involves citizens, municipal servants, local managers and other players interested in the city's development. This work further contributed to the elaboration and implementation of a vanguard project which will display information for decision-making, either to its local managers or to its citizens, allowing broader understanding on equals or similar projects. This work also contributes to the establishment of analogies among the cities.

The main limitation to this work had to do with the research methodology itself as it reduces pertinent analyses and considerations to a single city, so not thoroughly expressing the reality of Brazilian cities. There weren't restrictions as for the access of people to the project, nor to information or telecommunications of the city and of the City Hall. This in-progress project should not be compared to other already consolidated projects of big cities, mainly to Americans, Europeans and Japanese cities.

The conclusion reiterates the importance of a project methodology, collectively implemented by municipal servants, local managers, and citizens, and accepts it as an instrument to effectively contribute in the management of cities and in the implementation of strategic digital city projects. With the effective implementation of this kind of project, the democratic public space, the government management transparency, the effectiveness, and governability of municipal services, and the social, urban and regional development can be improved, consequently contributing for improving citizenship and the quality of citizens' life.

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